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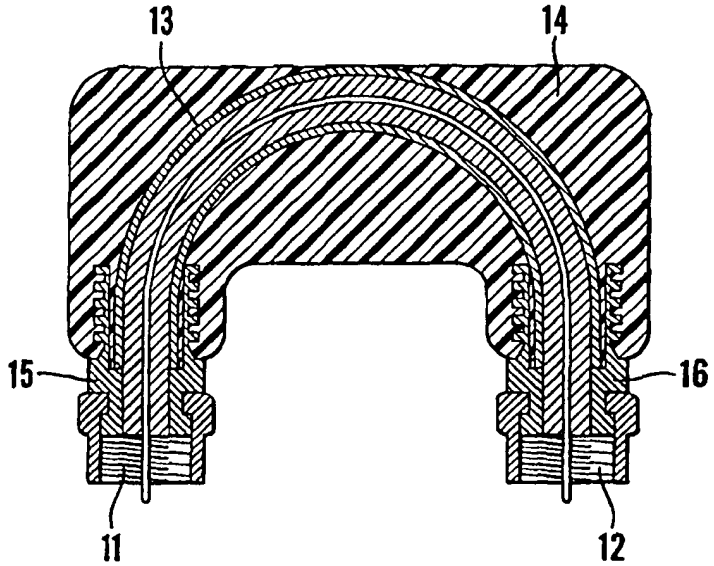
(54) Title: ELECTRICAL CONNECTOR

(57) Abstract

An electrical connector is provided for transmitting radio frequency electrical signals. The connector comprises a first f connector, a second f connector, a conductor extending between the first and second f connectors and a rigid jacket extending between the first and second f connectors and providing a waterproof seal encapsulating the conductor.



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Electrical Connector

TECHNICAL FIELD OF THE INVENTION

The present invention relates to an electrical connector and in particular, but not exclusively, to a connector for use in interconnecting the radio frequency signal through paths of pedestal mount taps.

BACKGROUND ART

A tap is used as a splitter to 'tap off' some of the power of a radio frequency (rf) electrical signal supplied to the tap so that it can be redirected to another user; e.g. as part of a cable television network to tap off rf power to the individual homes. A tap can have a number of ports, e.g. 2, 4,.8, and includes a through path so that a number of taps can be provided in series. A cascade of six 8 port pedestal mount taps would provide 48 sources of tapped rf power and would require five connectors to connect the through path for rf power between the first and second, second and third, third and fourth, fourth and fifth and fifth and sixth 8 port taps.

Six 9 port pedestal taps can be mounted on a chassis and fabricated into a single assembly by providing a through path electrical connector which is welded or otherwise permanently secured between the pedestal mount taps. However, should the installation engineer damage one of the ports of the taps when connecting cabling or otherwise installing the unit, the entire assembly needs to be

replaced. Further, such entirely rigid connections between the taps are susceptible to cracking and damage due to differential thermal expansion which can lead to the ingress of moisture which severely degrades the rf signal.

The through path ports can be connected by conventional co-axial cable. However, during installation co-axial cable is prone to damage as it is flexed back and forth by the engineer while making connections to the other ports and in the course of general handling. Again this can lead to the ingress of moisture and degradation of the rf signal. Further, there is no control over the curvature of the co- axial cable which also affects the quality of the rf signal. Furthermore, it is not possible to have a consistent connection quality between each of the taps of the cascade which can also affect the rf signal quality. The electrical and mechanical consistency of tap port connections is essential when taps are used in digital, telephony and data services.

Hence there is a need for a through port connector which allows for a modular assembly of multi-port taps while obviating the problems inherent in the use of conventional co-axial cabling.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided an electrical connector for transmitting radio frequency electrical signals, comprising a first f- connector, a second f-connector, a conductor extending between the first and second f-connectors and a rigid jacket extending between the first and second f-connectors and encapsulating the conductor.

Thus, the rigid jacket is able to provide an additional waterproof seal if necessary.

The industry standard rf applications terminal connector is known as an f-connector. The invention provides a connector having a pair of f-connectors with an electrical conductor extending between them and an outer coating, or jacket, which encapsulates the conductor so as to render the entire connector a hermetically sealed and rigidified unit. As the connector is rigid, it is not prone to damage by bending or impacts while manhandled during assembly. The material of the outer coating or jacket is such that the joints at the f-connectors cause the connector as a whole to be hermetically sealed in the sense that the ingress of moisture which can affect the internal conductor is prevented. The jacket is of a suitable material that it provides a rigid, rugged encasement of the electrical conductor yet is sufficiently flexible to allow for differential thermal expansion/contraction by the metallic elements of a tap cascade and so damage due to temperature change is obviated.

As the conductor is fixed and supported within the rigid jacket, a consistent mechanical and electrical connection is provided by the use of such rigid connectors. As a consistent mechanical and electrical connection can be provided the connectors allow for a modular approach to multi port tap cascades. It one of the pedestal mount taps is damaged, only the damaged pedestal mount tap need be replaced rather than the whole cascade providing savings in installation time and waste.

Preferably the two f-connectors are directed in generally opposed directions. A simple way of achieving this is for the connector to be U shaped. A generally U shaped connector allows for easy installation of the connector and access for a workman. As the jacket is rigid, the configuration of the electrical conductor is fixed and can be pre-selected so as to meet specific performance criteria during assembly of the connector and allows for consistent electrical performance between connectors.

The U shape may be substantially right angular. Although a rigid right angular U shaped jacket may be provided, to enhance the rigidity of the connector in preferred directions, the conductor encapsulated within the jacket may still have a smooth curved shape such that its electrical performance is not degraded.

Preferably, a radius of curvature of the conductor is selected so as not to degrade the radio frequency performance of the conductor. The selected curvature is maintained constant by the rigid encapsulating jacket thus ensuring a consistent rf performance.

Preferably the first f-connector and second f-connector are attached to the rigid jacket by high compression joints. High compression joints between the jacket and f-connectors help to hermetically seal the connector, prevent the ingress of moisture and also protect against rf leakage.

The first f-connector may be male. The first and second f- connectors may be male. The f-connectors may be any combination of male and female f-connectors as required by the specific application of the connector.

Preferably the conductor is co-axial cable. The conductor may be shielded co-axial cable. More preferably the conductor is a single piece of tri-shield RG59 coaxial cable.

According to a second aspect of the invention there is provided a cascade of pedestal mount taps having at least one radio frequency through path provided by an electrical connector comprising a first f-connector, a second f- connector, a conductor extending between the first and second f-connectors and a rigid jacket extending between the first and second f-connectors and encapsulating the conductor.

According to a third aspect of the invention there is provided a method of manufacturing an electrical connector comprising a first f-connector, a second f-connector, a conductor extending between the first and second f-connectors and a rigid jacket extending between the first and second f-connectors and providing a waterproof seal encapsulating the conductor, the method comprising the steps of:

assembling the first and second f-connectors and conductor in a jig to maintain the conductor in a preferred configuration;

providing a mould about the f-connectors and conductor and introducing a sealing compound into the mould;

leaving the sealing compound to cure; and

removing the mould and the sealed conductor and f- connectors from the jig once the sealing compound has cured sufficiently to provide a rigidified jacket to maintain the preferred configuration of the conductor.

Alternatively, the f-connectors and conductor can be enclosed within a pre-moulded jacket or a jacket moulded around the conductor and connectors in situ.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be better understood from the following detailed description of a specific illustrative embodiment with reference to the accompanying drawings, in which:

Figures 1a, b & c show perspective, side and end views of an electrical connector according to the present invention;

Figure 2 shows a cross section of the connector along line AA' as shown in Figure 1;

Figure 3 shows a part of the electrical connector during the manufacture process; and

Figure 4 shows a schematic illustration of connectors according to the invention in use interconnecting a cascade of three 8 port pedestal mounted taps.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The same items in different Figures share common reference numerals.

With reference to Figures 1a, b and c there are shown perspective, side and end views of an electrical connector, designated generally by reference numeral 10, according to the present invention. Figure 2 shows a cross section of such an electrical connector through line AA' of Figure 1c. The connector comprises a first f-type connector 11 and a second f-type connector 12. The f-connectors are RG59 crimp connectors. F-type connectors are industry standard in radio frequency (rf) applications. The first and second f connectors are high compression male f connectors.

A conductor in the form of co-axial cable 13 extends between the first and second f connectors. In particular, the co- axial cable is a single piece of tri-shield RG59 co-axial cable. The RG59 co-axial cable is attached to the first and second RG59 crimp connectors. The distance between the central conductor of the co-axial cable 13 is 40mm. The bend radius of the co-axial cable is selected so as to ensure good rf performance of the co-axial cable.

The conductor has a rigid jacket 14 in the form of a moulded plastics jacket made of a Macromelt moulding compound which encapsulates the conductor and is attached to the f- connectors by high compression joints 15, 16. The jacket provides a general rigidity and robustness to the connector such that it has a U

shape. Macromelt compound OM 638 has a shore A-hardness of 90, a tensile strength at rupture of 5.2Nmm^{-3}, dielectric constant (at 1kHz) of 4.7 and volume resistivity of $2.4 \times 10^{13}\Omega$cm. It has a glass transition temperature of -36°C, a softening point of 175°C and a viscosity at 210°C of 3700mPas.

Alternatively, the jacket could be moulded of any suitable plastics material and fitted around the conductor and f-connectors, or the conductor and f-connectors could be inserted into the mould prior to charging and the plastics jacket formed thereabout.

The connector has a substantially right angular U shape, but can accommodate a conductor with a smooth curved shape. The connector has a length of 55mm, a thickness of 13mm and a height of 37 mm.

The jacket is sufficiently rigid to protect the encapsulated co-axial cable, prevent damage and maintain the radius of curvature of the cable 13. However, owing to the nature of the jacket material, it is sufficiently resilient and pliant that it can accommodate slight changes in dimension without cracking or becoming damaged such that moisture can enter the connector. Hence it can accommodate differential thermal expansion/contraction of metal components without harming its integrity, which an entirely rigid, e.g. welded metal, connector can not.

With reference to Figure 3, the connector is manufactured by connecting a length of tri-shield RG59 co-axial cable 13 between a pair of RG59 crimp connectors 11,12. This assembly is then held in a jig such that the co-axial cable has a preferred radius of curvature such that its rf performance is not degraded. This configuration of the cable is maintained while the assembly is held in the jig. A mould is then assembled around the assembly and the plastics sealing compound which is to provide the rigid jacket is introduced into the mould and left to cure. Once the sealing Macromelt compound has rigidified sufficiently to maintain and

support the cable configuration, the mould may be removed and the connector removed from the jig.

Use of the connector of the present invention in a cascade of pedestal mount taps will now be described with reference to Figure 4. A cascade of three 8 port pedestal mount taps 41, 42, 43 mounted on a chassis 44 is shown in Figure 4. RF power is supplied to an input port 45 of a first tap 31 and low intermodulation circuitry in the tap splits the incoming rf power to provide rf signals at the eight output ports.

An electrical connector 46 according to the invention is connected across the power through output port of the first tap 42 and the power through input port of the second tap 42 so that rf power is provided to the second tap in the cascade. Similarly a second electrical connector 47 according to the invention is provided to provide through rf power from the second tap 42 to the third tap 43.

The connection of further cabling to the ports of the taps has previously tended to cause damage to the through power inter-connector, resulting in inconsistent rf performance, when in the form of a flexible co-axial cable or can damage the port terminals. But the rigidity of the electrical connector of the current invention minimises damage and helps to prevent moisture degradation of the rf signals. If a one piece cascade assembly is used then a single damaged port on one tap means that the whole assembly needs replacing resulting in substantial wasted installation time, equipment and loss of service to the customer. However, using the connector of the current invention a modular installation method may be used and only the damaged tap need be replaced rather than the entire cascade. The U shape of the connector eases installation of a cascade for the technician as the power through ports of the taps can easily be mated with the f-connectors which are presented directly to them.

CLAIMS

1. An electrical connector for transmitting radio frequency electrical signals, comprising a first f connector, a second f connector, a conductor extending between the first and second f connectors and a rigid jacket extending between the first and second f connectors and encapsulating the conductor.

2. A connector as claimed in claim 1, in which the connector is U shaped.

3. A connector as claimed in claim 2, in which the U shape is substantially right angular.

4. A connector as claimed in claim 2 or claim 3 in which a radius of curvature of the conductor is selected so as not to degrade the radio frequency performance of the conductor.

5. A connector as claimed in any preceding claim, in which the first f connector and second f connector are attached to the rigid jacket by high compression joints.

6. A connector as claimed in any preceding claim, in which the first f connector is male.

7. A connector as claimed in claim 6, in which the second f connector is male.

8. A connector as claimed in any preceding claim in which the conductor is co-axial cable.

9. An electrical connector for transmitting radio frequency electrical signals, comprising a first f connector, a second f connector, a conductor extending between the first and second f connectors and a rigid jacket extending between the first and second f connectors and providing a waterproof seal and encapsulating the conductor.

10. A series of pedestal mount taps having at least one radio frequency through path provided by an electrical connector as claimed in any preceding claim.

11. A method of manufacturing an electrical connector comprising a first f-connector, a second f- connector, a conductor extending between the first and second f-connectors and a rigid jacket extending between the first and second f-connectors and providing a waterproof seal encapsulating the conductor, the method comprising the steps of:

assembling the first and second f-connectors and conductor in a jig to maintain the conductor in a preferred configuration;

providing a mould about the f-connectors and conductor and introducing a sealing compound into the mould;

allowing the sealing compound to cure; and

removing the mould and the sealed conductor and f-connectors from the jig once the sealing compound has cured sufficiently to provide a rigidified jacket to maintain the preferred configuration of the conductor.

12. A method of manufacturing an electrical connector comprising a first f-connector, a second f- connector, a conductor extending between the first and second f-connectors and a rigid jacket extending between the first and second f-connectors and providing a waterproof seal encapsulating the conductor, the method comprising the steps of:

assembling the first and second f-connectors and conductor in a jig to maintain the conductor in a preferred configuration;

providing a mould about the f-connectors and conductor and introducing a plastics material into the mould in a fluid state;

allowing the plastics material to solidify; and

removing the mould and the sealed conductor and f-connectors from the jig once the plastics material has solidified sufficiently to provide a rigidified jacket to maintain the preferred configuration of the conductor.

13. An electrical connector substantially as hereinbefore described with reference to the accompanying drawings.

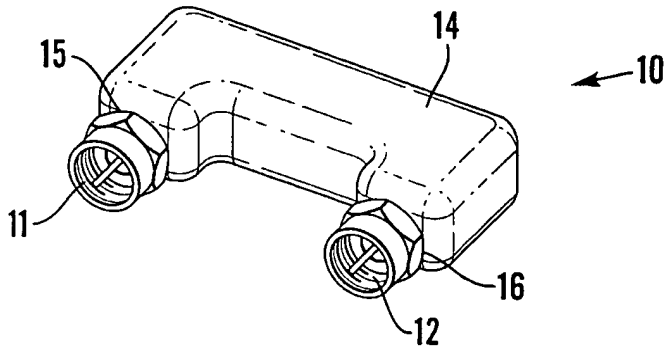

Fig. 1a

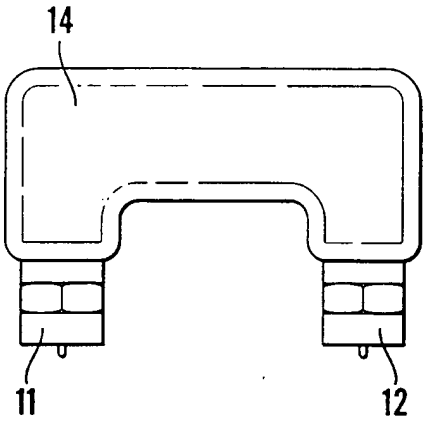

Fig. 1b

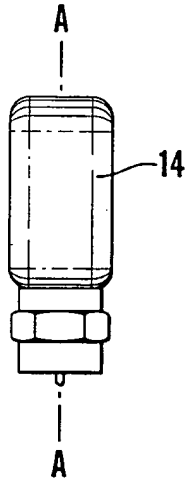

Fig. 1c

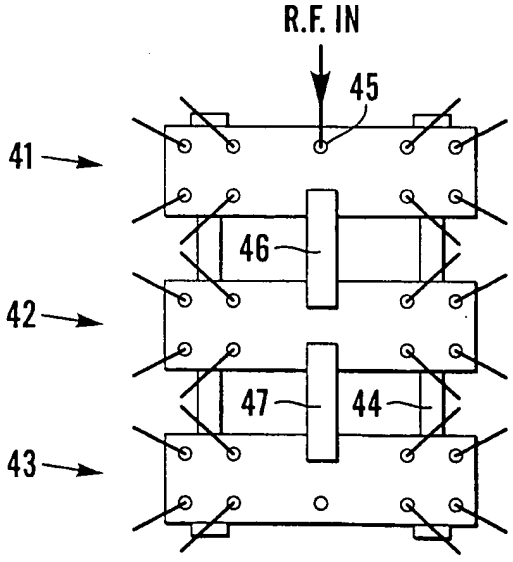

Fig. 4

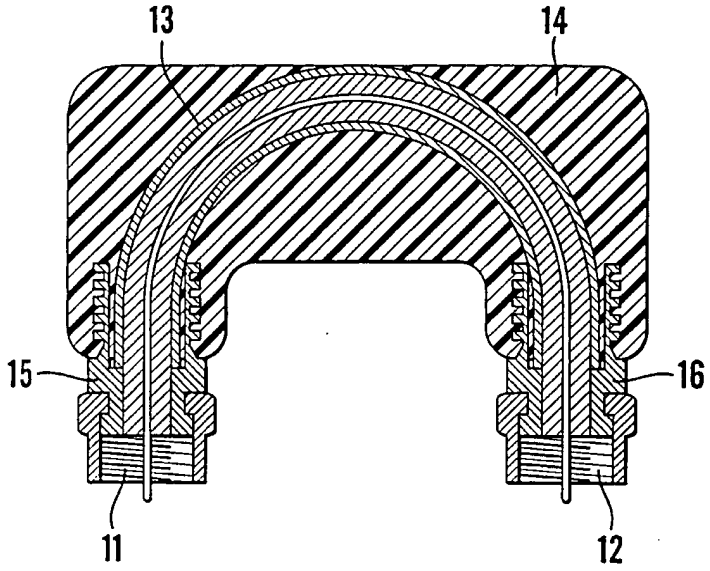

Fig.2

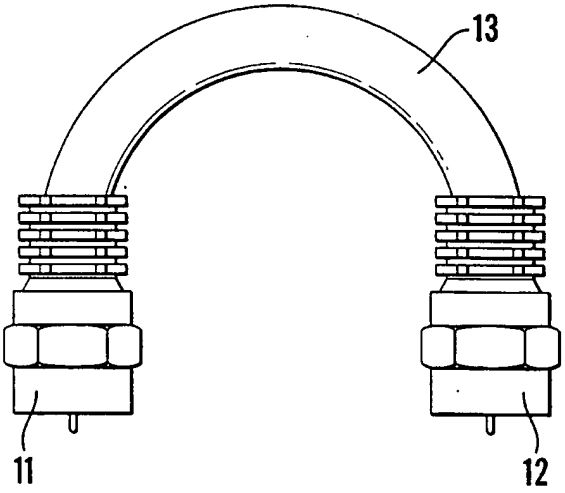

Fig.3

INTERNATIONAL SEARCH REPORT

Int ional Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R17/12 H01R13/646 H01R13/52

According to International Patent Classification (IPC) or to both national classification and IPC

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 503 942 A (RADIALL SA) 15 October 1982 (1982-10-15) page 3, line 7 -page 4, line 31; figure 5	1-3,6,8, 13
X	US 5 277 590 A (THOMAS CHRIS ET AL) 11 January 1994 (1994-01-11) column 1, line 59 -column 2, line 47; figure 1	1,6,8,9, 13
A	US 3 636 239 A (ROBBINS ARTHUR M) 18 January 1972 (1972-01-18) column 1, line 46 -column 2, line 46; figure 1	1-13
A	US 3 665 601 A (DUNBABIN JOHN G) 30 May 1972 (1972-05-30)	1-13

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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